GEMINI

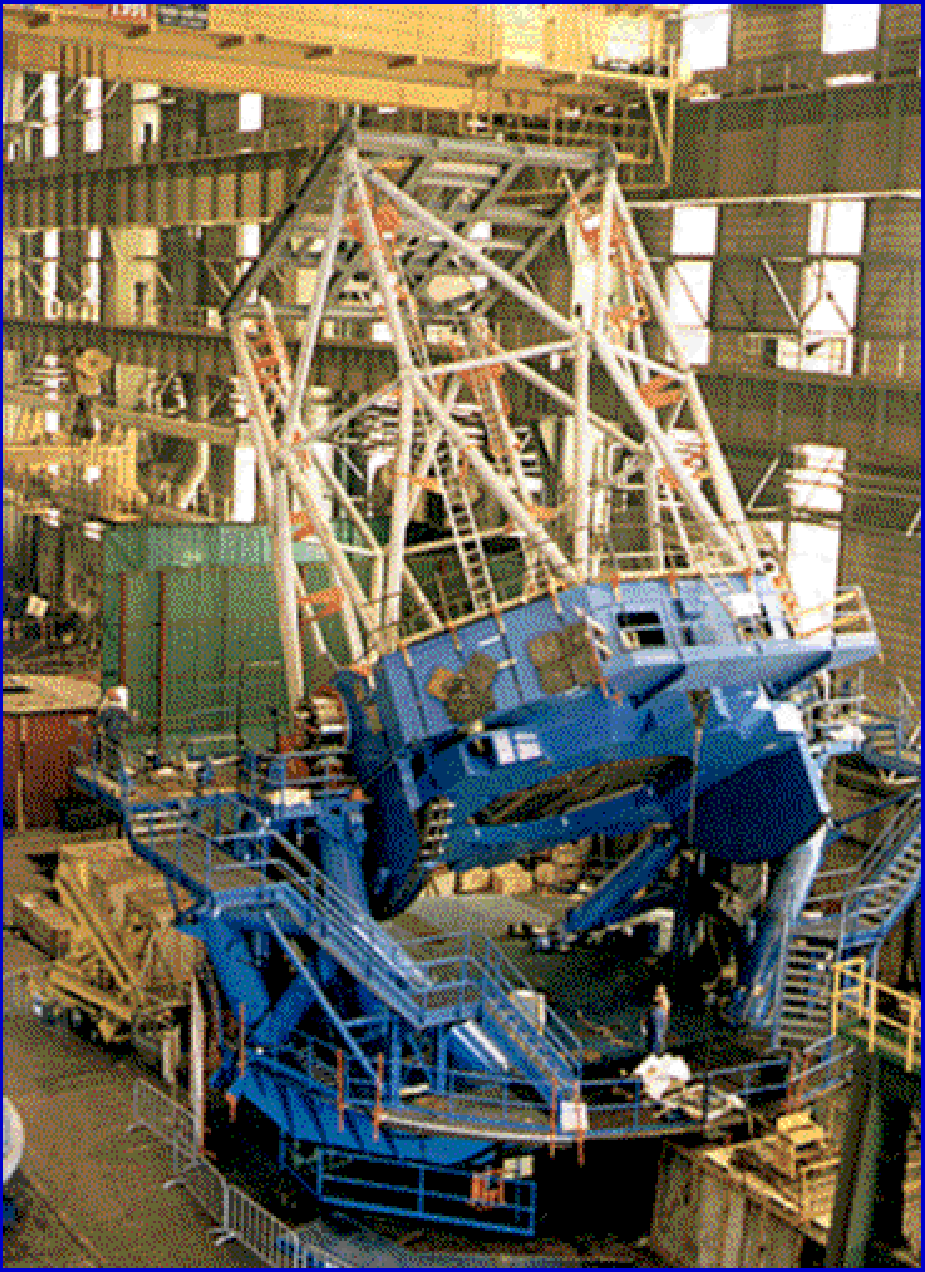
NEWSLETTER

Issue 14 June 1997

"First Oil" for Gemini North

GEMINI

8-Meter Telescopes Project



Testing the telescope control system at TELAS/NFM.

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United States • United Kingdom • Canada • Chile • Brazil • Argentina

Setting the Scene for Gemini Operations

As we move into 1997, the Gemini "Project" has started to receive its first operations budget to allow us to put into place the first elements of the Gemini "Observatory". With the Gemini Observatory we are planning to move away from the classical operating philosophy of current ground-based telescopes. The Gemini 8-M telescopes have to support a large and diverse user community spanning at least six countries. These telescopes are the premier national facilities for infrared and optical astronomers in each of the Gemini partner countries and, as such, are likely to be highly over-subscribed. If time is awarded in the traditionally allocated 2-3 night blocks, an individual user is unlikely to obtain more than 2-3 nights per semester on these telescopes. With this approach, the probability that an individual user can exploit the superb imaging and emissivity characteristics of the Gemini telescopes in the best atmospheric conditions is small. We are planning to operate the Gemini telescopes in a different way, where observations can be matched to conditions, where programs can obtain small blocks of time to broaden the user base, and where the engineering teams can optimize their support activities based on scientific priority. We call this model the *"adaptive operations model."* To get a feel how the Gemini adaptive operations model might look to an astronomer, imagine being on Cerro Pachon in the early years of the next century.

It is nightfall on Cerro Pachon and the Gemini support associate and staff astronomer are working through the beginning of the night's queued observations. While the support associate is watching the satellite weather maps to see how long the current conditions will last, the staff astronomer is discussing with his colleague in La Serena which mix of observations will make the best use of tonight's expected conditions. They re-run a couple of options through the automatic scheduler since the Hilo crew has asked if Gemini South could run through a few calibration observations to complete last night's Mauna Kea file.

In the same room, an engineer is trouble shooting an off-line instrument via a video conference link to the Mauna Kea base facility where the expert for this instrument is currently working. They compare notes, decide that it is the same problem fixed earlier this month on Mauna Kea, and transfer the patch file.

A few hours later, as the Mauna Kea support associate is running through the nightly start-up calibration of the telescope pointing and image quality, the support associate for Cerro Pachon starts up a video link. She is having problems with the M1 support system and wants to consult. While the Mauna Kea telescope automatically runs through its calibration procedure, the two support associates decide that it is the active actuator system that may be causing the problem. As the Mauna Kea support associate has been through this procedure before, he logs into the Cerro Pachon M1 support system using an engineering display and has a detailed look at the actuators' performance. Isolating it to a particular actuator that is misbehaving, he advises the Cerro Pachon support associate how to turn off a particular support actuator. The Cerro Pachon support associate does so and then logs the problem in a distributed problem reporting system that will be used the next day by the day crew and engineering team to repair or replace the actuator.

As the support associate on Cerro Pachon is starting an infrared spectroscopic observation of a high red-shift galaxy, it becomes obvious that there is something peculiar about its emission lines. The staff astronomer decides that this is worth calling the principal investigator in Cambridge, England. After a brief teleconference discussing the different aspects of the spectrum, the PI decides to log on from home and remotely look at the extracted spectrum himself.

The next observation is listed as classical remote observing and the observers in Tucson and Sao Paulo have been waiting patiently to connect to the system and observe. In Tucson the PI dials up the Gemini ISDN number and establishes a connection to the site - giving her control of the science operations. As she works, the telescope updates a video image of the guide field as well as allowing her to interact via a full screen X Window display - identical to that available on site. From Sao Paulo her colleague has connected to the data reduction system, and is "leafing through" the night's calibration files to see if he can find suitable arc and flat field frames. The same video links allow both the observers in Tucson and Sao Paulo to interact with both the support associate and the staff astronomer on Cerro Pachon. Next month, the two observers are scheduled to use the remaining four hours of their allocation to repeat the same observations on a northern sample, using the Mauna Kea Gemini telescope.

-Matt Mountain
Director
-Rick McGonegal
Controls & Instrumentation Manager

Project Status Update - June 1997

Throughout the project, construction activity for both Gemini telescopes continues to progress rapidly. Although schedules in a number of areas (most notably the enclosure, primary mirror cell, and secondary mirror) have gotten very tight, we are still aiming at first light for the Mauna Kea telescope by the end of 1998.

Cerro Pachon site construction in January 1997.

San Juan Construction is well along with outfitting the support facility at the Mauna Kea site and has started work on outfitting the enclosure base. They will complete their work this summer in time to start installation of the azimuth track and telescope structure in August 1997.

Design of the Gemini base facility in the University of Hawaii Hilo Research Park is complete. The Gemini Hilo base facility will be located adjacent to the Joint Astronomy Centre and is designed to integrate with the JAC. Construction will start this month and be completed in March 1998. In the meantime, office and warehouse space has been leased to accommodate the growing Gemini team in Hilo until the new base facility is ready.

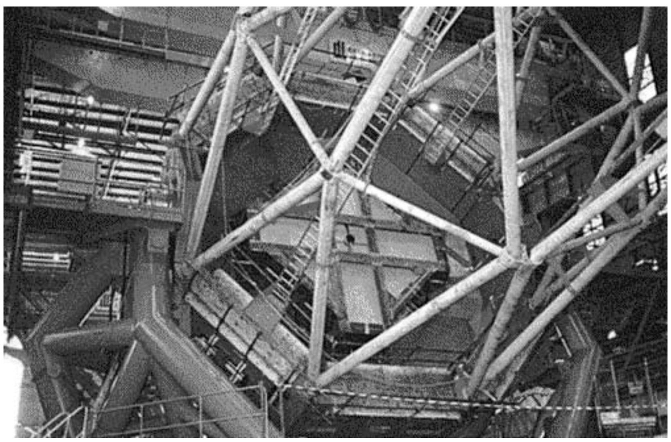
At Cerro Pachon we have decided to perform the outfitting of the Cerro Pachon site facilities using multiple subcontracts. Exterior cladding of the site facility started in April of this year. Procurement of the plant equipment for the Cerro Pachon facility is nearing completion and much of it has already arrived in Chile.

Despite a series of severe storms in the first three months of 1997, Coast Steel has made considerable progress with erecting the Mauna Kea enclosure. Delays due to the weather have forced us to adopt many workarounds to allow telescope installation to start on schedule in August 1997 and proceed in

The Mauna Kea enclosure in April 1997.

parallel with completion of the enclosure. Shipping of the fabricated elements of the Cerro Pachon enclosure to Chile has started and erection will begin in September 1997. Completion is scheduled for mid-1998.

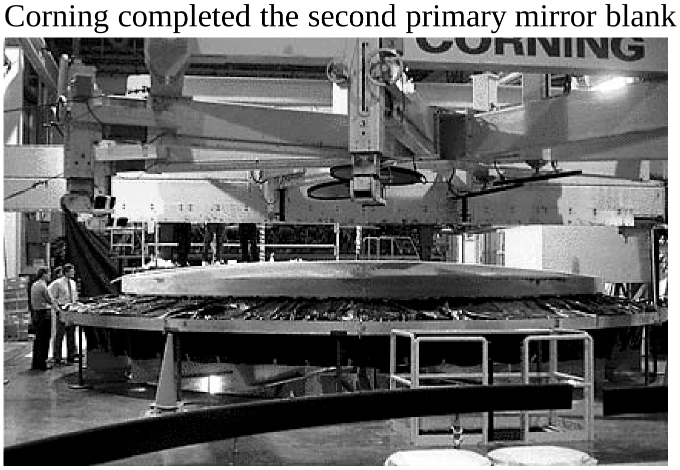
Preassembly of the first telescope structure at the Telas/NFM factory in Le Creusot, France, was completed in March 1997. Following testing in April of the mount control system with the altitude drives of the assembled telescope, the structure was disassembled and prepared for shipment to Hawaii. It will arrive on the Big Island in August 1997.



The telescope structure at TELAS/NFM.

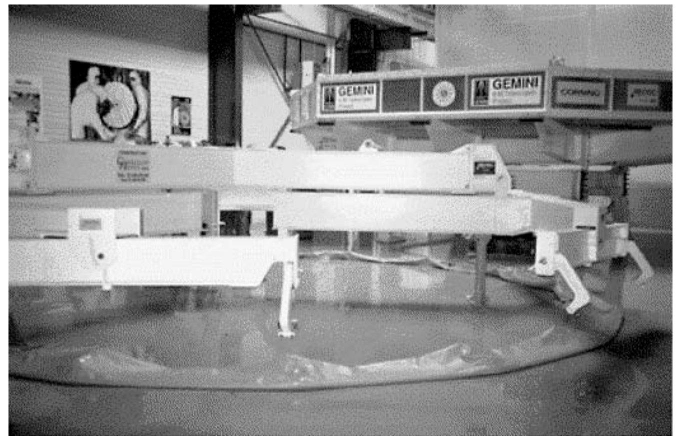
The Mauna Kea coating plant vacuum and sputtering systems are tested and ready for shipment to Hawaii. The vacuum vessel is scheduled to arrive on the Big Island in mid-July 1997, and will be the first Gemini superheavy load to be transported from the port at Kawaihae to the summit. The coating plant will be assembled and tested in the enclosure base during the fall of 1997.

Corning completed the second primary mirror blank ahead of schedule in April 1997, and it was shipped to REOSC in May.



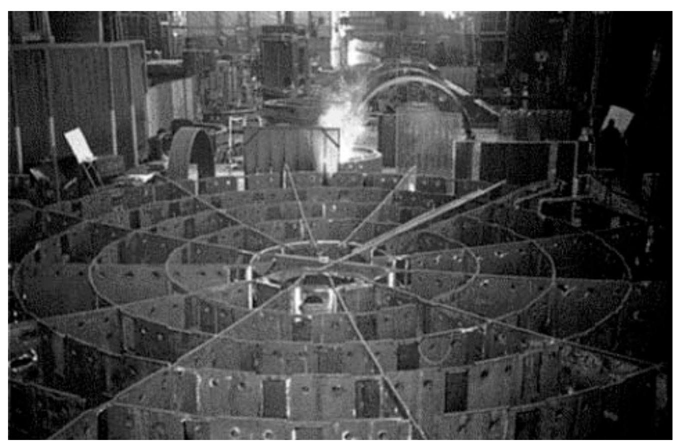
The second primary mirror at Corning.

Grinding on the first primary mirror at REOSC was finished in February at a figure accuracy better than one micron rms. Polishing started in May following changeover of the metrology mount from VLT to Gemini configuration.



The first primary mirror at REOSC.

Preparations are well underway for assembly and testing of the primary mirror cell assemblies at the Telas/NFM factory starting in June 1997. Fabrication of the first mirror cell structure at Telas/NFM will be completed in early June. RGO has all of the mirror support system components ready for installation into the structure as soon as it is ready.



The primary mirror cell structure at TELAS/NFM.

Morton has experienced serious difficulties in producing a silicon carbide secondary mirror blank under their subcontract to Zeiss. In response to this contingency, Zeiss has launched an aggressive effort to produce a backup lightweighted glass secondary mirror on a schedule that preserves first light at

Mauna Kea in December 1998. Zeiss and Morton are proceeding with production of two SiC secondaries. The first will replace the glass secondary at Mauna Kea prior to the start of scientific operations. The second SiC mirror will go to Cerro Pachon and the glass secondary will be kept as a spare. Fabrication of the secondary mirror tip/tilt/chopping, slow positioning, and deployable baffle mechanisms is well underway and will be completed well in advance of the delivery of the backup glass secondary mirror.

With two exceptions, work is progressing satisfactorily on all of the software and control work packages. Because of difficulties in both Canada and Tucson with hiring programmers with the requisite skills, the Data Handling System and Interlock Safety System have fallen behind schedule. Fortunately, these delays will not jeopardize the Mauna Kea schedule for first light.

All of the work on facility instrumentation is progressing on schedule. Critical design review of the acquisition and guiding opto-mechanical assemblies was held in April 1997 at Zeiss. Preliminary design review of the natural guide star adaptive optics system for the Mauna Kea telescope will take place in October 1997 at Dominion Astrophysical Observatory. The wavefront sensor work at RGO and the Cassegrain rotator, cable wrap, and instrument support structure fabrication at Advance Mechanical Optical Systems are on track.

Several major review milestones for scientific instruments were passed in the last six months. Conceptual design reviews were completed in January 1997 to conclude four competitive mid-infrared imager design studies performed in the U.S. community. Preparation of a request for proposals to design and build a mid-infrared imager for Gemini is underway. Critical design review of the near-infrared imager that the University of Hawaii is building for Gemini was completed in May, and the critical design review of the Gemini near-infrared spectrograph is scheduled for October 1997 at NOAO.

Critical design review of the Gemini multi-object spectrograph was completed in March 1997. The technical design produced by the GMOS team in the UK and Canada is excellent, but unfortunately, the estimated cost to build and commission the instrument has increased significantly. Plans to implement some of the future upgrades to the two GMOSs have had to be put on hold to provide the funds needed to complete the basic instruments. The three critical issues identified at the conceptual design review of the Gemini high resolution spectrograph last November have been successfully resolved. However, the concept for this instrument presented by the University College London team at the review is being simplified to meet the basic science requirements at a cost Gemini can afford.

-Richard Kurz
Project Manager

Future Gemini Instrumentation

I. INTRODUCTION

The Gemini telescopes are designed to excel in key areas, e.g. excellent sites, superb imaging quality, throughput and IR emissivity, and the capability to exploit the best observing conditions with innovative scheduling.

However, providing two superb telescopes is only part of the job. If Gemini is to attain a prominent role in astronomy, the telescopes must be operated in a fashion to allow the partner communities to effectively and efficiently carryout frontier observations, and the Gemini instrumentation capabilities have to continue to evolve to exploit new scientific opportunities and technology developments as they become available.

The capabilities of the initial complement of instrumentation (see Gemini Newsletter #10, June 1995) will allow the Gemini communities to undertake a broad range of scientific programs. The Gemini on-going instrumentation program is intended to provide the key capabilities beyond those offered by the initial instrumentation that will keep the Gemini facilities at the forefront of astronomical research well into the 21st century.

In order to ensure the continuing relevance of the Gemini On-going Instrumentation Program, international scientific reviews will be held every two to three years, providing an opportunity to reevaluate the content and direction of the instrumentation program from a scientific and technical perspective. The first of these International Gemini Instrumentation Workshops was held at Cosener's House, Abingdon, England on 18 and 19 January 1997.

The recommendations generated by the Workshop will be adopted as guidelines for formulating the Gemini on-going instrumentation program. Due to funding constraints and technological considerations it may not be possible to implement all the recommendations.

II. SCIENCE ISSUES AND OPPORTUNITIES

The Workshop considered scientific issues in four broad areas; stars and planetary systems, star formation and the interstellar medium, galactic structure and nearby galaxies, and formation and evolution of galaxies and cosmology. No attempt has been made to ensure comprehensive coverage of all observational astronomy fields; rather the goal was to identify the key instrumentation capabilities based on illustrative problems from a wide range of astronomical disciplines in order to ensure that the recommended capabilities would enable observations addressing these as well as many other scientific opportunities.

A. Stars and Planetary Systems

Science programs considered in this area included:

1) Searches for and studies of brown dwarfs and giant planets.
2) Studies of the physics of stars and stellar atmospheres, including convection, magnetic fields, and basic parameters of temperature and surface gravity, particularly in lower mass stars.
3) Pursuit of the age-abundance relationship in nearby galaxies and globular clusters, as well as the abundances, luminosities and mass loss rates of supergiants in different environments in nearby galaxies.
4) Study of accretion effects including "flickering" in low mass Xray binaries, and circumstellar disks and/or outflows for young and old luminous B stars.

B. Star Formation and the Interstellar Medium

The Gemini telescopes will play a central role in our quest to understand stellar and planetary birth more deeply -- by virtue of their potential to provide diffraction-limited images from 1.6 microns to 20 microns, and light gathering power sufficient to permit moderate- to ultrahigh resolution infrared and optical spectroscopy of both deeply embedded

Figure 1. The brown dwarf candidate GL 229B lies 7.2 arcsec from A and is 10 mag fainter. In the near-infrared with high order AO and coronagraphic optics the Gemini telescopes could detect brown dwarfs and possibly gas-giant planets within a fraction of an arcsec of nearby stars.

and optically-revealed young stars and their circumstellar environs.

Illustrative examples considered included:

1) Determination of the initial mass function in a variety of environmental conditions; in isolation, in small aggregates and in rich dense clusters of stars.
2) Probing the physical structure and ionization state of low density molecular material, and the physical and chemical state of molecular cores.
3) The detailed study of the structure of young stellar object envelopes and the processes of infall and outflow in their immediate vicinity.
4) Study of young sub-stellar companions to pre-main sequence stars and debris disks around nearby main sequence stars.

C. Galactic Structure and Nearby Galaxies

The Gemini telescopes will offer a wide range of capabilities for studies of galaxies in the nearby universe. The overarching scientific theme is exploration of energetic processes occurring on spatial scales of a few parsecs or less. Within this category are individual massive stars, compact star clusters extending from young "super star clusters" to the true globular clusters, and galactic nuclei. That objects existing on such small spatial scales can have important influences on galaxies is well known, but until the advent of high angular resolution images with the Hubble Space Telescope, the richness of these small but powerful astrophysical systems was only faintly recognized. For nearby objects, access to both hemispheres is a major advantage in allowing us to reach key examples of various classes of galaxies.

Illustrative examples considered included:

1) Determination of mass loss rates of massive OB stars in nearby galaxies.
2) Study of dust-embedded "super star clusters" and their effect on surrounding environment.
3) Study of the stellar populations and dynamical properties of galaxies out to the Fornax and Virgo clusters, the stellar populations of the innermost regions of nearby galaxies, and the IMF for violent star formation episodes in a significantly large sample of galaxies.

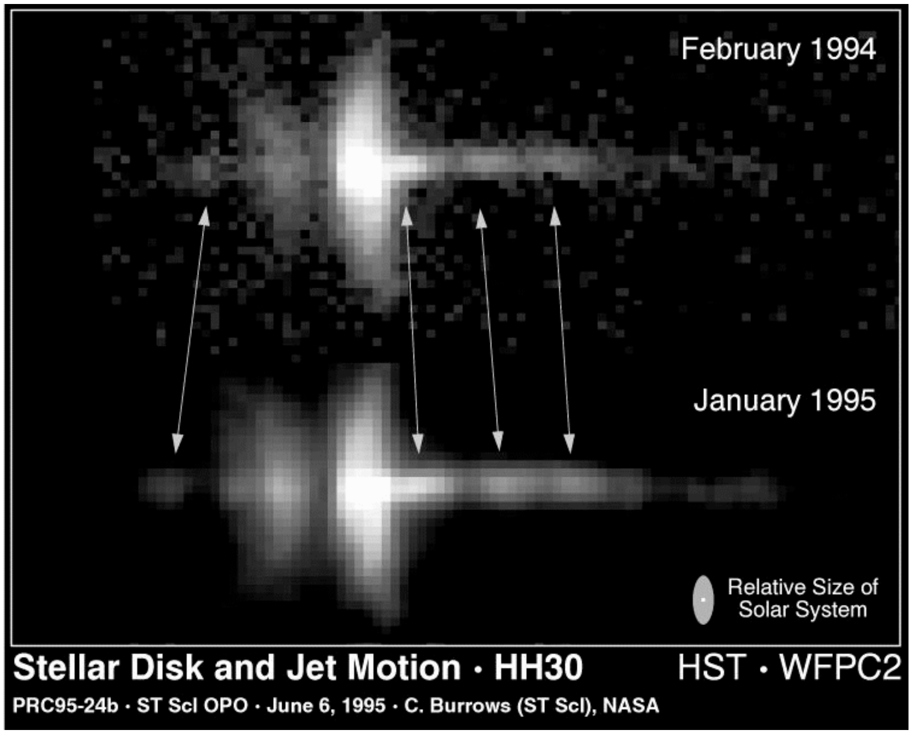


Figure 2. An HST images of the edge-on low mass star associated with the HH30 jet. The opaque circumstellar disk surrounding HH30 appears in shadow against the bright, dish-like scattered-light region (the remnant infalling envelope) seen above and below the disk. Emerging from HH30 is a highly-collimated, ionized jet, believed to be driven by processes related to accretion of material through a magnetized disk. Gemini would have four times the spatial resolution (at 2 microns) as this I-band image, and would enable large samples of objects - many younger and more deeply embedded - to be analyzed. Critical to the success of these observations is coronagraphic and polarimetric capability: most objects lack the favorable geometry of HH30, in which the central object is obscured by a nearly edge-on disk.

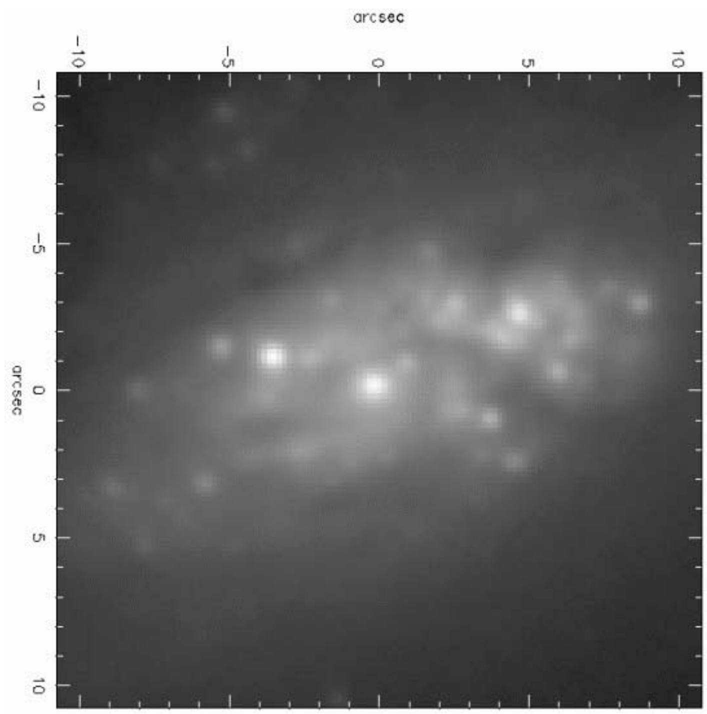


Figure 3. Infrared image of the dusty "hotspot" region surrounding the nucleus (bright central source) of the SBc spiral galaxy NGC 2903. This picture shows the colors in the JHK-bands from observations made with the Palomar Hale 5-m telescope with 0.6 arcsec FWHM seeing. Comparisons with images taken with WFPC2 on the Hubble Space Telescope with resolution comparable to that expected for Gemini in the JHK-bands demonstrate that many of the bright IR condensations around the nucleus are compact super star clusters. These types of clusters are common in starbursts and other areas of intense star formation, and can be readily investigated with large aperture, high angular resolution telescopes operating in the optical through mid-infrared spectral regions. This image was obtained by Alan Watson, Keith Matthews, and John Trauger.

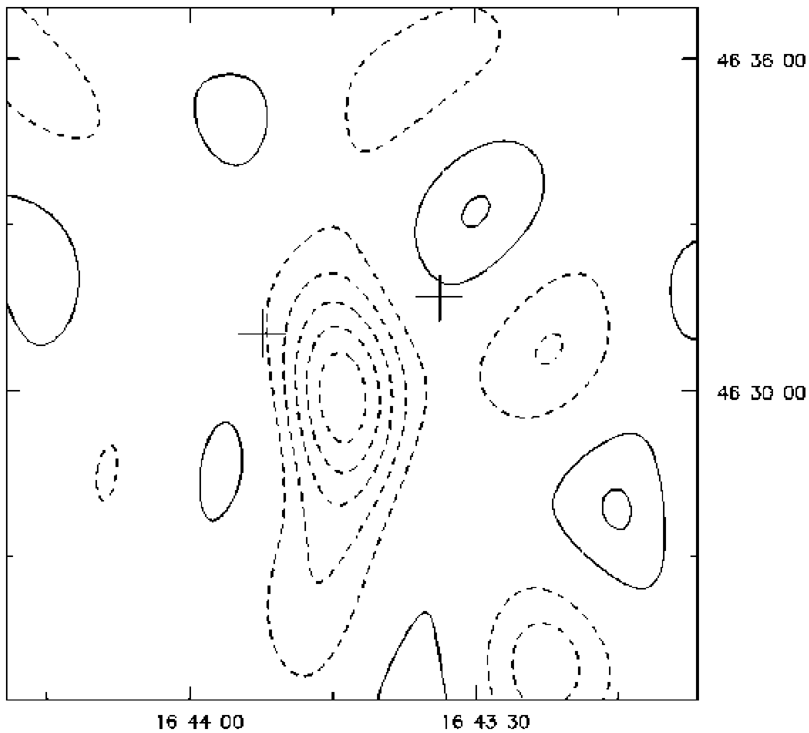


Figure 4: The Sunyaev-Zeldovich effect detection towards 1643+46, a pair of z=3.8 quasars separated by 198 arcsec (plotted here as crosses). Contour levels are -325 to +130 μJy in steps of 65 μJy; dashed contours are negative. The implied gas mass exceeds 2 x 10^{14} M$\odot$ (or a total mass above 10^{15} M$\odot$ but there is as yet no corresponding detection in the X-ray waveband, or an obvious rich cluster in 4-m near-infrared images. It is hard to escape the conclusion that this is an ultramassive system at z > 1. Optical and near-infrared follow-up will only be possible with telescopes with the light grasp of Gemini.

4) Studies of the nuclear regions of nearby galaxies, investigating the origin of nuclear starbursts, the AGN-starburst connection, and massive black holes at the centers of galaxies.

D. Formation and Evolution of Galaxies and Cosmologies

The highlights of scientific topics described in this section included:

1) Investigations of galaxy evolution, including studies of z>1 clusters discovered via the Sunyaev-Zeldovich effect,. lensed galaxies and lenses, and galaxies very close to quasar lines of sight.
2) Studies of the astrophysics of active galactic nuclei, including feeding of the monster, and geometry and emission mechanism of AGN's.
3) Investigations using galaxies as probes of large scale structure in the universe, including using supernovae to determine q_o, and studies of optically selected galaxies at z>1.
4) Studies of quasars and the high-Z universe determining temperature, velocity and abundance measurements of high-Z absorption line systems toward very high-Z quasars.

III. RECOMMENDED ELEMENTS OF THE ON-GOING INSTRUMENTATION PROGRAM

The scientific perspectives outlined above identified instrumentation capabilities for the Gemini ongoing instrumentation program. The mapping of science programs onto instrumentation capability is summarized in Tables 1 and 2. Table 1 summarizes new instrumentation capabilities as derived from the scientific discussions, while Table 2 summarizes the capabilities that can be satisfied, at least in the near term, by upgrades to Phase I instrumentation or by the shared use of Michelle or Phoenix. The very strong overlap apparent in Tables 1 and 2 among the different scientific areas leads naturally to the following broad consensus for the direction of the ongoing instrumentation program.

1) The ability to obtain near diffraction-limited imaging capabilities for near-IR wavelengths at both sites through implementation of adaptive optics (AO) is of paramount importance in effectively addressing key scientific issues over the whole range of topics outlined in Section II. Recent advances in the demonstration of the scientific utility of AO and of laser beacon capabilities have highlighted the timeliness of this capability. Efforts to maximize sky coverage by the implementation of laser beacon AO technology are of very high priority. The Gemini telescopes will complement and extend HST performance at near-IR wavelengths, and will provide spatial and spectral resolution capabilities in the 2-20μm atmospheric windows far superior to the capabilities of ISO and those planned for SIRTF. In the 10 and 20μm windows, the Gemini telescopes will provide diffraction-limited images even without AO.

2) Technological advances in near-IR arrays enable new innovative instrumentation capabilities that will fully exploit the images delivered by the Gemini telescopes at wavelengths longward of one micron and allow new attacks on key scientific issues throughout the science program; e.g. detailed studies of star formation processes, and extending many extragalactic studies to higher redshift. The development of high performance 1kx1k and 2kx2k near-IR arrays open new possibilities for addressing many of the key scientific issues using integral field, multislit, and multi-object spectroscopic capabilities at near-IR wavelengths.

Superconducting tunnel junctions (STJs) may offer the possibility of very high efficiency low resolution spectroscopy from the atmospheric cutoff in the UV to near IR wavelengths. Pulse counting detectors with high quantum efficiency still offer significant advantages in extreme photon-starved problems.

High efficiency innovative grating developments would push the capabilities of the Gemini spectrographs to the faintest possible limits and immersed grating technology could extend the spectral resolution capabilities of GMOS and NIRS.

Table 1 - Science Drivers for New Instrumentation Capabilities

SCIENTIFIC PROGRAMS	A&G Polarization Modulator		AOS		IR Imager/ Coronagraph	IR MOS						Hi Stab Lab Spec		
			LGS	NGS		>3' FOV		AO		IFU				
	0.4 - 1μm	1 - 5μm	>0.4	>0.9		30K	5K	30k	5k	30k	5k	150k	300k	500k
A. Stars & Planetary System														
--BD & giant planets				X	X					X	X	X	X	
--physics of nearby stars							X		X				X	
--stars in other galaxies			X		X		X		X		X			
--surface structure / active processes	X	X	X										X	
B. Star Formation & ISM														
--initial mass function			X		X				X					
--molecular clouds & cores														
--disks & envelopes		X	X		X					X				
--young substellar objects			X		X						X	X		X
C. Galactic Structure & Nearby Galaxies														
--massive stars			X						X		X	X		
--star clusters			X		X				X		X			
--galactic nuclei			X		X				X		X			
D. Formation & Evolution														
of Galaxies/Cosmology														
--evolution of galaxies			X				X		X		X			
--studies of AGN's	X	X	X		X				X		X			
--galaxies probes of HiZ structure			X				X		X					
--QSO's as probes of HiZ universe			X		X						X			X

Table 2 - Science Drivers for Upgrades and Shared Instruments

SCIENTIFIC PROGRAMS	UPGRADES: HROS R=120k	UPGRADES: MK AOS LB	UPGRADES: GMOS 0.1" IFU	UPGRADES: GMOS 1-1.5 μm	UPGRADES: GMOS R=25k	SHARED INSTRUMENTS: NIRS IFU	SHARED INSTRUMENTS: NIRS R~25k	SHARED INSTRUMENTS: MICHELLE	SHARED INSTRUMENTS: PHOENIX
A. Stars & Planetary System									
--Brown Dwarfs & giant Planets	X					X		X	X
--physics of stars	X								X
--stars in other galaxies	X				X		X		X
--active stars								X	X
B. Star Formation									
--initial mass function		X							
--molecular clouds & cores							X	X	X
--disks & envelopes		X				X	X	X	X
--young substellar objects		X	X						
C. Galactic Structure & Nearby Galaxies									
--massive stars	X								X
--star clusters	X	X	X		X	X	X	X	
--galactic nuclei	X	X	X		X	X	X	X	
D. Formation & Evolution of Galaxies/Cosmology									
--evolution of galaxies		X	X	X	X				
--AGN's		X	X	X					
--galaxies as probes of structure		X	X	X	X				
--QSO's & Hi-Z universe	X	X	X	X	X			X	X

3) In general, although important scientific applications for wider fields than provided by Gemini's f/16 focus were identified, it is recommended that Gemini should concentrate its instrument development effort on exploiting the baseline f/16 focus. Innovative means for providing the Gemini communities access to wide field capabilities on other large telescopes, such as sharing time with other large telescope facilities, should also be explored.

A. Recommended New Instrumentation Capabilities

1. Natural Guide star (NGS)/Laser Beacon (LB) AO System at Cerro Pachon

The Gemini-S facility will be a superb facility for Adaptive Optics observations. A combined NGS/ laser beacon AO system will extend and complement the AO capabilities on Gemini North. The combination of AO implementation at Gemini-S, together with the laser beacon upgrade and the Phase I NGS AOS for Gemini-N will constitute a powerful integrated AO program for the Gemini telescopes. These capabilities combined with the recommended optimized small field near-IR imager and spectroscopic capabilities will enable new scientific programs throughout the whole scope of scientific issues addressed by the workshop.

When combined with a near-IR WFS for tip/tilt and fast focus correction, a laser beacon AO system would enable high performance AO imaging and spectroscopic observations in dark clouds - one of Gemini's key science drivers. Adaptive Optics optimized for coronagraphic imaging and with high (>0.9) near-infrared Strehl ratios, is a key capability in the search for giant planets around nearby stars.

2. IR Imager at Cerro Pachon

1-5μm imaging will be a "workhorse" capability for Gemini, exploiting the superb image quality and extremely low emissivity of the telescopes. Furthermore, Gemini will be a unique platform for coronagraphic observations because of the exceptionally smooth primary mirror, rigorous mirror cleaning program, thin secondary vanes, etc. A small field imager with pixel scales and optics designed to exploit AO performance and t/t corrected images with optimized near-IR coronagraphic imaging capability will address a very wide range of science topics.

3. IR MOS, 1-2.5μm at Cerro Pachon

The continued development of large format near-IR arrays (2kx2k HgCdTe arrays for the 1-2.5µm regime are under development and possibly buttable InSb arrays) provides an opportunity for three powerful new capabilities in the area of 1-2.5µm multi-object spectroscopy.

- *5"-10" IFU with coronagraph; R = 5000-8000, R ~ 30,000.* One key Near-IR MOS mode would be a high spatial resolution IFU that adequately samples AO corrected images, possibly equipped with coronagraphic capability. More than one IFU may be required to work in the three Near IR bands. An IFU with a FOV of 5-10" and 0.05-0.1" sampling was identified as being required for studies in crowded regions and of galactic nuclei.
- *Multi-slit MOS within isoplanatic patch R = 5000-8000, R ~ 30,000.* A second mode would be the capability to select numerous objects for spectroscopic study within a FOV consistent with AO isoplanatic patch size, about 20-30" dia. Many applications for this type of MOS will be in crowded complex fields, so multi-slits or even multi-2D capability would be required.
- *MOS within FOV >= 5' R = 5000-8000.* The third key capability is simultaneous spectroscopy of objects over a FOV comparable to that of GMOS at the f/16 focus, particularly for studies of the distant universe. It is noted that over a 9' FOV the telescope emissivity increases by only 1%, making a truly wide field instrument possible.

For many science applications the spectral resolution needs to be optimized to work between the OH airglow lines, between 5000 and 8000, while abundance measurements will require spectral resolutions around 30,000. This capability supports a range of scientific applications, many of which follow the themes of GMOS science to higher redshift or probe dusty environments.

The cryogenic MOS slit masks or other object selection mechanism would have to be changeable during an observation session without warming the spectrometer, or significantly interrupting operations. Similarly the changeover between IFU and MOS operation should not require warming the instrument. A minimum array format for these capabilities is 2kx2k, with a goal to achieve 4kx4k pixels.

Given the complex issues surrounding implementation of the wide range of scientifically compelling MOS capabilities in the near IR, which include the possibilities of implementing upgrades to GMOS and NIRS, the Workshop suggests the following course of action:

- Assess design concepts of new Near IR MOS instruments, including estimates of design/fabrication schedules
- Assess the impact of upgrades to GMOS and NIRS in the overall scientific and programmatic context of the on going instrumentation program
- Develop an optimal approach to implementing the three Near IR MOS capabilities discussed above.

4. *A&G Polarization Modulator / Optical & IR - Mauna Kea & Cerro Pachon*

Polarization measurements will require implementation of a polarization modulator in the A&G unit above the bottom port. The NIRI and NIRS Phase I instruments can accomodate Wollaston prism polarization analyzers, however, implementation of polarizing capability in GMOS and HROS will require upgrades to the Phase I instruments.

5. *High Stability Lab Spectrometer - Cerro Pachon*

The High stability Lab in the telescope pier provides a stable environment for precision radial velocity measurements. A fiber-fed, bench-mounted optical spectrograph with R=120,000, usable with an absorption cell in 500-600 nm range, would provide the greatest sensitivity currently for detection of low mass companions. A higher resolution mode, R>300,000 over the 380 to 1000 nm range, would enable many studies in stellar physics, including convection and magnetic fields, and also sufficient resolution for detailed studies of the interstellar medium.

B. Recommended Upgrades to Phase I Instrumentation Capabilities

1. Laser Beacon AO System Upgrade - Mauna Kea

A Laser Guide Star upgrade to the NGS AOS would boost AO sky coverage at moderate Strehl ratios in the near-IR. The intent is to be able to upgrade the initial NGS AOS for use with a Na Laser beacon in order to achieve moderate Strehl ratios (around 0.5) in the near-IR over most of the sky. Lasers are currently forbidden on MK as are the currently FAA required radar-based aircraft protection schemes. Intensive efforts are underway, led by Keck, to obtain approval for Na laser beacons on MK and FAA approval of alternative passive aircraft detection schemes.

2. GMOS Near IR Upgrade - Mauna Kea

Upgrade GMOS-N with the addition of a 2kx2k HgCdTe array under development at Rockwell International, to provide high performance multi-object spectroscopy over a roughly 3 arcmin dia field in the 1-1.5μm region. The same camera could also be fed with an IFU. This upgrade provides near term capability for near infrared, full field, MOS capability. A significant constraint on the upgrade path is to preserve the optical spectroscopy and imaging capability in the GMOS.

3. Near IRS IFU Upgrade - Mauna Kea

The NIRS is designed to have significant space in front of the cold slit for an Integral Field Unit (IFU). Because of the "small" 1kx1k format of the NIRS detector, an image slicer concept for the IFU, which maps slices of the image plane into a single long slit, would provide efficient use of the array and require no additional blocking filters.

The initial NIRS IFU implementation should be kept relatively simple, since this is a new capability, with little experience concerning implementation or use. Switching between IFU plate scales and between IFU and long slit use should not require warming of the dewar.

4. HROS R=120,000 - Cerro Pachon

This capability is required to disentangle the effects of temperature and velocity in absorbing clouds along the line of sight to quasars. The recommended bench mounted R=120,000 capability could also provide for much of the science drivers for this upgrade.

5. Grating Improvements (GMOS) - Mauna Kea and Cerro Pachon

The largest single source of throughput loss in GMOS is the grating efficiency (at 65-70%). Possible high efficiency innovative grating developments would push the capabilities of GMOS to the faintest possible limits. Grating developments to allow spectral resolutions of 20,000 to 30,000 would fill the gap between the baseline GMOS and HROS.

1) Shared Instrumentation

1. Mid-IR Spectrograph (MICHELLE) (shared with UKIRT) Mauna Kea

A Mid-IR spectrometer under development at ROE for use at UKIRT and proposed for shared use on Gemini-N. It will provide spectral resolution from 200 to 30,000, and diffraction limited imaging capability in the 8 - 28μm range. Under the proposed shared-use agreement, MICHELLE would be available at Gemini-N 50% of the time.

It would be very desirable to have MICHELLE available for use at the start of scientific operations on Gemini-N.

2. Near-IR HRS (PHOENIX) (shared with NOAO) - Cerro Pachon

Phoenix is a near-IR high resolution spectrometer, providing spectral resolution up to 100,000 in the 1-5μm range. It saw first use on NOAO telescopes in 1996. The shared use of PHOENIX at Gemini-S and possibly Gemini-N should be pursued. Because of the initial scarcity of science instruments on Gemini-S, It would be very desirable to have Phoenix available for scientific use on Gemini-S late in the commissioning period and during early operations of Gemini-S.

Ultimately this spectroscopic capability will be needed with a much larger simultaneous wavelength coverage than can be provided by Phoenix, however Phoenix would offer an adequate capability for the short term. The provision of a new instrument for that would provide extended wavelength coverage in a single exposure should appear later in the on-going instrumentation program

IV. ACKNOWLEDGEMENTS

We would like to recognize and acknowledge the scientists that participated in the Abingdon Workshop, and their time and effort that were essential to the success of this endeavor.

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Phil Puxley

-Fred Gillett

Reports from the National Project Offices

US Gemini Project Office

The US Gemini Project Office (or US Gemini Program as we regard it here) has been principally engaged in three tasks during the past six months: helping to define a new organizational structure for NOAO that most effectively addresses the functions required for KPNO, CTIO and US Gemini in the operations era; the procurement and monitoring of the US instrument work packages; and, to a lesser extent, considering what we can and should do to support outreach and the public understanding of science – both within the US and collectively with our Gemini partners.

Some structural changes are taking place involving the US Gemini Program and its parent organization, the National Optical Astronomy Observatories. In the past, NOAO consisted of divisions with a great deal of scientific autonomy. The detailed rules and processes through which the astronomical community used Kitt Peak were not identical to those for CTIO. NOAO is in the process of restructuring itself so that one division, the USGP, has responsibility for all the "before and after the observing run" activities associated with the use of all the telescopes, those at Kitt Peak, those at CTIO, the U.S. share of Gemini, and the national access time granted by some of the independent observatories. These activities include the proposal and time allocation processes, support for proposal preparation, observing run preparation, and data reduction, archiving of data, and general scientific outreach. This large increase in responsibility is associated with an increase in the staff size including astronomers, programmers, and administrative experts to manage the proposal and data flow. We anticipate that this evolution will substantially increase the effectiveness with which we can serve the U.S. astronomical community and with which we can contribute to Gemini.

Work is underway on the procurement of CCDs and CCD controllers for the focal plane arrays in the optical instruments, GMOS and HROS. The CCDs will be purchased from EEV (a British company) and will have a format of 2048 by 4608 pixels, each pixel being 13.5 microns square. The CCDs are buttable on 3 sides and each GMOS focal plane array is made of three CCDs butted on their long sides. This produces a detector that is 62 by 83 millimeters. The production of the controllers will be a collaborative effort, with the hardware coming from San Diego State University and the software being developed by a team including RGO and NOAO programmers.

An international review committee met in January to consider four conceptual design and feasibility studies for a Gemini mid-infrared imager. These were submitted by Ron Garden (University of California-Irvine), George Rieke (University of Arizona), Charlie Telesco (University of Florida), and Doug Toomey (Mauna Kea Infrared). The committee concluded that a diffraction-limited, single plate scale, 8-26μm camera devoid of non-essential features was both scientifically interesting and affordable. Procurement of this instrument will be made through a competitive proposal process open to anyone in the US. Proposals will be solicited this summer and we expect to have someone under contract by September.

The near-infrared imager (NIRI) and spectrograph (GNIRS) are both progressing well. The NIRI team at University of Hawaii just held their critical design review in mid-May and the GNIRS team at NOAO is working towards their critical design review in October. It has been recently agreed that in addition to the baseline science requirements, GNIRS will also incorporate the science goals of cross dispersion, a 100 arcsec long slit, a blue short camera of 0.15 aresec/pixel, higher spectral resolution of ~18,000, and upgrade paths for integral field mode and a Wollaston prism. Progress has been made at Santa Barbara Research Center towards the fabrication of the Gemini 1024x1024 InSb array detectors needed for NIRI and GNIRS. We hope to have the first two of twelve arrays fabricated and ready to characterize at

NOAO this summer. Finally, NOAO is also working towards completing and shipping the first IR array controller to the NIRI team in October.

As previously stated, we have made an effort to identify the necessary and appropriate outreach functions which might be undertaken by the Gemini international and national project offices. These functions include a wide variety of tasks intended to inform the scientific community and public about Gemini and to assist in educating and exciting students, teachers, and citizens at large about astronomy, science, and technology.

Although most outreach plans focus on the "first light" and operations era, one program is under development now. This is a planetarium show which will feature Gemini within the broader context of infrared astronomy and "Origins" science. The planetarium production will be funded by the sponsors of the UK/AZ Festival, a month-long event organized by the city of Phoenix and the British consulate to highlight and promote British connections in Arizona. The new Phoenix Science Center and Planetarium needed a theme for the Festival and Gemini as an example of UK/AZ cooperation was the perfect choice. The show kit can be reproduced and widely distributed at low cost to interested planetariums everywhere. By seeking, sharing, and leveraging opportunities available to us we can stretch our modest resources to accomplish meaningful outreach programs of value to Gemini's future.

-Kathy Wood and Todd Boroson

UK Gemini Project Office

The first Gemini Instrumentation workshop was held in Abingdon, Oxfordshire in January. The meeting outlined the future directions for the first instruments to be constructed from the operational phase of the project and we hope that it will also contribute to the development of collaborative instrument projects among the partners. After the meeting, the project scientists visited the REOSC factory south of Paris where the primary mirrors are being ground and polished and the NFM Telas factory at Le Creusot where the telescope structure is being built. The capabilities of both facilities were very impressive and it was reassuring to see the evident pride in the work carried out for Gemini. We were all moved by seeing the realization of the telescope designs in glass and metal and are grateful for the efforts of the many people in many countries who have contributed to progress so far.

The instrument teams at Durham, ROE, DAO and UCL developing GMOS and HROS are continuing to make progress. The GMOS CDR was held (and passed) in February while questions raised at the HROS CoDR were satisfactorily answered in early March. The detailed workscopes of the next stages of these projects are now under discussion. Construction of Michelle (a mid-IR instrument to be shared between UKIRT and Gemini-N) is accelerating at ROE and the instrument is scheduled to be delivered to Hawaii late next year. The forthcoming Gemini Science Committee meeting will be held in Edinburgh, which will allow the members to see a number of instrument modules before assembly.

The coating plant development at the RGO is proceeding on schedule with the first chamber due for delivery to Hawaii later this year. The RGO is also gearing up for the installation of the primary mirror support system at NFM. The active support modules and control system are packed ready for transport to France once the fabrication of the mirror cell is complete. As this is being typed, the first tests of the telescope structure with the mount control system developed at RGO are getting underway, while the CDR for the acquisition and guiding system is imminent.

With the construction of the telescope systems well underway, we are now starting to develop plans for operational support. Ensuring that cooperation with the national Gemini offices in the partnership is maximized whilst achieving synergy with the other UK telescopes will be a high priority.

-Pat Roche

Canadian Gemini Project Office

We are now starting to plan for the Gemini operations era, and the implications for supporting the Canadian Gemini user community. In the coming months we expect to work with Phil Puxley and with the other National Gemini Offices to help define the role of DAO in the operations era, and the associated schedule. Todd Boroson's planning effort for the US Gemini Program has also been very helpful to us.

Gordon Walker, who has served Gemini and Canada so well since the earliest days, has announced his retirement this summer from the University of British Columbia and from his position as Canadian Gemini Project Scientist. Gordon was the key Canadian figure in developing consensus within the Candian astronomical community for joining the Gemini partnership. One of Gordon's greatest strengths has been his statesman-like approach to even the most difficult of problems faced by Gemini over the years. This approach, coupled with his broad knowledge of observational astronomy and astronomical instrumentation, earned and retained the confidence of all who worked with him.

Gordon will be succeeded in July by Jean-René Roy of Université Laval, who is currently a GSC member and who has had a long-standing and keen interest in Gemini. Jean-René will also succeed Gordon as one of the two Canadian Gemini Board members. He can be reached at *jrroy@phy.ulaval.ca*.

The development team for the Data Handling System unfortunately lost Dayle Kotturi, who wrote the article on DHS in the last newsletter. We were very sorry to lose Dayle, but the good news is that IGPO quickly offered her a job, so she will not be lost to Gemini.

-Andrew Woodsworth

Chilean Gemini Project Office

The main news from this side of the world is:

1. Considerable effort was spent in diffusing Gemini activities in Chile in the last few months. Several seminars have been given in various universities of the country like U. Concepción; U. Valparaíso and others.

2. We are about to start the second phase of the communication work package for Gemini. This will consist of elaborating the conceptual design for the Gemini communication system. REUNA, a Chilean engineering firm who was involved in the previous phase will continue with this work in collaboration with IGPO. The previous phase involved the definition for the preliminary requirements of the communication system for Gemini.

3. The Gemini law, which contains Chile’s contribution to the project, was introduced into the House of Representatives on March 4 of this year. It is expected to be approved by mid april and inmediately after, it will be submitted to the Senate together with the Astronomy law. Because of their similarities, it is expected that both laws will be dealt at the Senate at the same time. The Astronomy law contains provisions for tax exemptions for items related to astronomy projects in Chile and also requirements to include Chilean firms and professionals in the construction and operation of new astronomical projects in Chile.

4. The Puclaro Tunnel on the new road to Cerro Pachón is being constructed according to the new dimensions (11 meters wide) agreed between AURA and the Ministry of Public Works in Chile.

- Oscar Riveros

Argentine Gemini Project Office

Beginning February 21st, 1997, a joint resolution issued by the SECYT (Secretary of Science and Technology) and the CONICET (National Research Council) has established that the responsibility of Argentina with the Gemini Project lies in the CONICET. The document on the Abingdon Workshop on the Gemini Instrumentation is being distributed to the Argentine astronomical community and is creating more and more interest in everything concerning the Gemini Project. We are presently organizing our participation in the meeting that the Brazilian colleagues are organizing for the latter part of the year to discuss Gemini observing plans and cooperation among astronomers of the Mercosur countries.

-Jorge Sahade

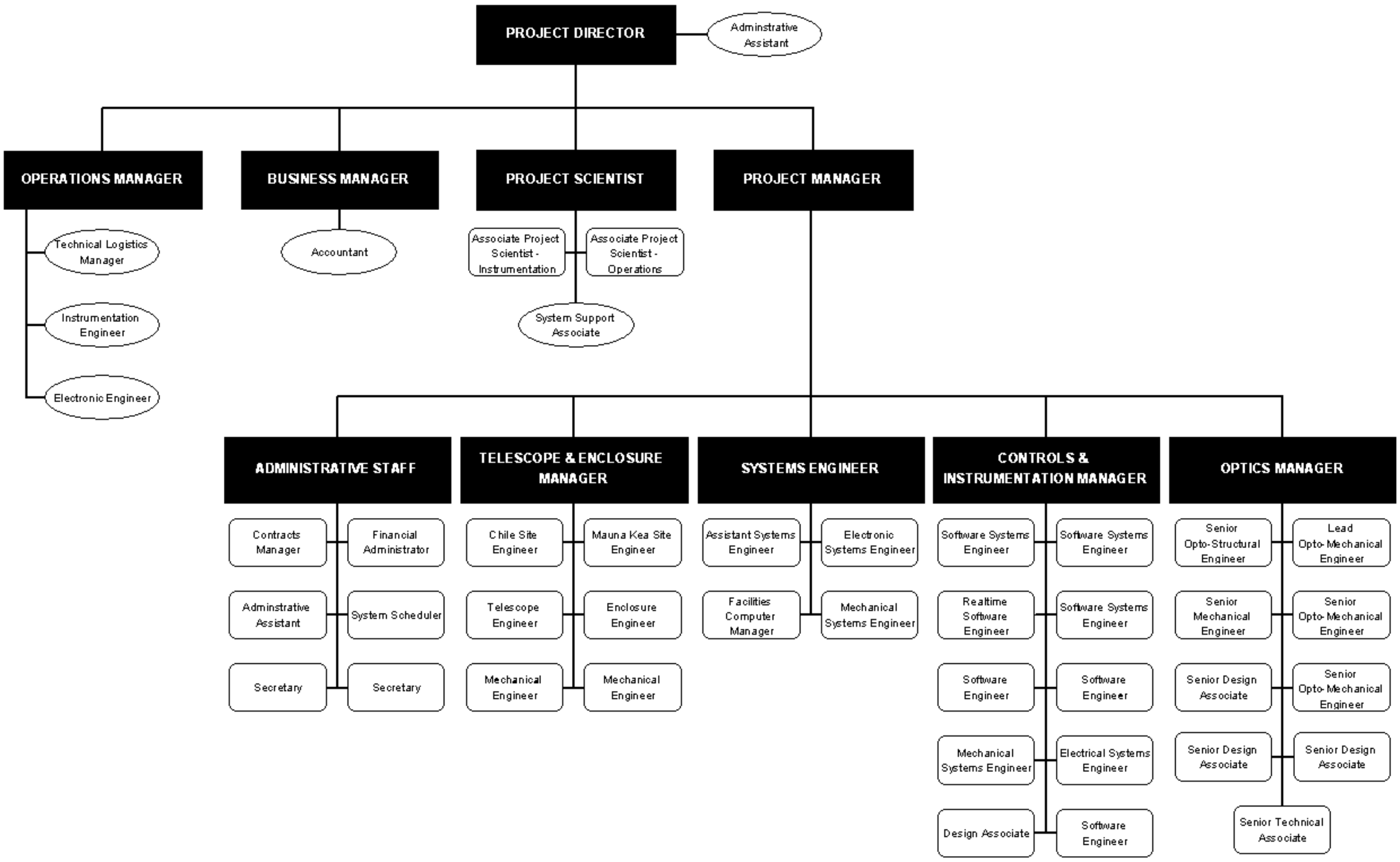
Released Documentation

The following documents have been released by the Gemini Project since the last edition of the Gemini Newsletter (December 1996). Copies of these and other publications are available either via Gemini's Documentation page on the Web site at *http://www.gemini.edu/documentation/*, or on request by contacting the Gemini Project systems librarian at the project address, or by emailing *rkneale@gemini.edu*. Document numbers are listed in parentheses. **Please note:** This list does not include any Interface Control Documents. For current ICDs, please see the Gemini ICD Database Tool at *http://www.gemini.edu/systems/ icd_main.html*.

- Gemini Observatory Optomechanical Coordinate System. Oschmann, 11/21/96 (ICD-G0014)
- MCS Control System Design Description. Wilkes, 11/25/96 (SPE-C-G0069)
- The CICS Alpha Review Documents. Beard, 11/28/96 (REV-C-G0089)
- MCS CDR Documents. UKGPO, 12/03/96 (REV-C-G0088)
- SCS Alpha Review Documents. Paterson, 12/04/96 (REV-C-G0090)
- Wind Spectra for Gemini. McGonegal, 12/30/96 (TN-C-G0046)
- SCS Prototype Review Report. Smith, 12/31/96 (REV-C-G0091)
- PCS Prototype Review Report. Smith, 12/31/96 (REV-C-G0092)
- HROS CoDR Final Report. McGonegal, 12/31/96 (REV-I-G0094)
- Gemini Aladdin Controller Design Review Materials. 01/10/97 (REV-I-G0095)
- MCS CDR Report. Wilkes, 01/13/97 (REV-C-G0093)
- Gemini Instrumentation Workshop. Gillett, 01/18/97 (SWG-I-G0040)
- Observations of Millimetre-Wavelength Hydrogen Recombination Lines in the Galaxy NGC253. Puxley, 01/28/97 (Preprint #18)
- The TCS Alpha Review. Mayer, 01/30/97 (REV-C-G0096)
- Gemini Record Reference Manual. Goodrich/ Foster, 01/30/97 (SPE-C-G0070)
- CICS Beta Review. Beard, 02/06/97 (REV-C-G0097)
- A&G PDR. Zeiss, 02/17/97 (REV-C-G0100)
- GMOS CDR. ROE, 02/26/97 (REV-C-G0099)
- SCS Alpha Review Report. Stewart, 02/27/97 (REV-C-G0098)
- Scientific User Requirements for the Gemini Phase I Applications Tool. Puxley, 03/01/97 (TN-I-G0049)

Staff Changes at Gemini

This organization chart reflects the start of the buildup of the Gemini operations staff. During the transition period from now to handover to scientific operations, an Operations Manager and a Business Manager will supervise the buildup of the technical and administrative operations staff. Ken Krohn has moved from his position as Contracts Manager for the construction project to Business Manager for Gemini. We are currently advertising to fill the Operations Manager position and many of the positions on the operations technical staff (see the Gemini Web page for details). The positions in ovals are new hires on the operations staff so far in 1997.



Mauna Kea construction in April 1997.

GEMINI

8-Meter Telescope Project

THE GEMINI 8-METER TELESCOPES PROJECT is an international partnership managed by the Association of Universities in Research in Astronomy under a cooperative agreement with the National Science Foundation.

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